REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1, 4-13, 20-23, 25-26, 33-38, 52, 65, and 83-84 are presently active in this case, Claims 24, 29-32, 55-56, 59-62, 78-82 canceled, Claims 1, 8, 34-36 amended; and Claims 83-84 added by way of the present Amendment.

In the outstanding Official Action, Claims 81 and 82 were rejected under 35 U.S.C. § 112, first paragraph; Claims 1, 4-7, 11-13, 20-21, 23, 31-33 and 52 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Publication 2003/0176060 to Doan et al.; Claims 8 and 10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Doan et al. in view of U.S. Patent Publication 2001/0054769 to Raaijmakers et al.; Claim 9 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Doan et al. in view of Raaijmakers et al., and further in view of U.S. Patent Publication 2003/0031793 to Chang et al.; Claims 22 and 34-38 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Doan et al. in view of U.S. Patent No. 6,607,973 to Jeon; Claim 24 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Doan et al. in view of U.S. Patent No. 6,572,705 to Suntola et al.; Claims 25-26, 52 and 79-80 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Doan et al. in view of U.S. Patent No. 6,818,517 to Maes; Claims 59-60 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Doan et al. in view of U.S. Patent Publication 2002/0182320 to Leskela et al.; Claims 61 and 62 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Doan et al. in view of Jeon, and further in view of U.S. Patent Publication 2003/0049372 to Cook et al. and Claim 78 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Doan et al. in view of U.S. Patent No. 6,946,336 to Pang et al.

With regard to the rejection under 35 U.S.C. § 112, first paragraph, Claims 81 and 82 have been canceled. Therefore, the rejection is moot.

In order to expedite issuance of a patent in this case, Applicants have amended Claim 1 to recite further details that address concerns raised in the Response to Arguments portion of the Final Action. Specifically, the Response to Arguments portion of the Office Action expressed concern that the claims broadly recite forming "a hafnium oxide film made with any type of precursor, any type of substrate, and other broadly cited process conditions (i.e., chamber pressure, etc.)."[1] Applicants have amended Claim 1 to recite further details of the process of forming the hafnium oxide film.

Specifically, Applicants' Claim 1 as amended recites a method of forming a film including HfO_2 on a substrate, the method including providing a plurality of substrates, each having a diameter greater than about 195 mm, on respective surfaces of a tier substrate holder in a process chamber of a batch type processing system, maintaining the process chamber at a pressure of between 0.05 Torr and about 2 Torr, and heating the substrates to a temperature of between 100° C and 600° C. Also, recited is flowing a pulse of a hafnium-containing precursor in the process chamber by flowing a hafnium-containing precursor liquid into a vaporizer at a flow rate of between 0.05 ccm (cubic centimeters per minute) and 1 ccm, the hafnium-containing precursor comprising $Hf(NEt_2)_4$, $Hf(NEtMe)_4$, or a combination thereof. Also recited is flowing a pulse of a reactant gas in the process chamber at a flow rate of between 100 sccm and 2000 sccm; and repeating the flowing process until a HfO_2 film with desired film properties is formed on the substrates having acceptably constant properties across all substrates in the plurality of substrates on the tier substrate holder.

1 See Final Action at p. 3, lines 8-10.

Thus, in response to the Response to Arguments portion of the outstanding Office Action, Applicants have amended Claim 1 to expressly recite:

(1) Constant property result: "having acceptably constant properties across all substrates of the plurality of substrates in the tier substrate holder." This limitation is supported at least by paragraphs 27 and 28 of Applicants' specification as originally filed.

(2) Type of precursor: "the hafnium containing precursor comprising $Hf(NEt_2)_4$, $Hf(NEtMe)_4$, or a combination thereof." This limitation is supported at least by paragraph 42 of Applicants' specification and original claim 24.

(3) Flow rate of the precursor: "a hafnium containing precursor liquid into a vaporizer at a flow rate of between 0.05 ccm (cubic centimeters per minute) and 1 ccm." This limitation is supported at least by paragraph 53 of Applicants' specification and original Claim 60.

(4) Flow rate of reactant gas: "between 100 sccm and 2000 sccm." This limitation is supported by paragraph 53 of Applicants' specification as originally filed.

(5) Chamber pressure: "maintaining the process chamber at a pressure between 0.05 Torr and about 2 Torr." This limitation is supported by paragraph 53 of Applicants' specification and original Claim 32.

(6) Chamber temperature: "heating the substrate to a temperature between 100° C and 600° C." This limitation is supported by paragraph 53 of Applicants' specification and original Claim 27.

(7) Type of substrate: "diameter greater than about 195 mm." This limitation is supported by paragraph 32 of the specification and claim 24.

As discussed in Applicants' specification, the present inventors recognized the problem of providing uniform ALD process results at different wafer positions in a batch type processing chamber. Based on this recognition, the present inventors conducted experiments

to analyze the effect of different process parameters on a batch process for depositing HfO_2 film. Figures 10-13 of Applicants' specification show one example of tests conducted by the present inventors in an effort to improve uniformity of process results across a batch of wafers. Applicants respectfully submit that the inventors identified at least the process parameters listed above as suitable for performing an ALD HfO_2 deposition process in a batch type processing chamber with acceptably constant properties across all substrates. The cited prior art references do not, either alone or in combination, teach or suggest the combination of recited elements now included in Claim 1.

First, the primary cited reference to Doan et al. teaches only the general concept of ALD applied to a plurality of wafers in the batch processing system. This reference is directed to pre-cleaning of the plurality of substrates in order to facilitate the batch ALD process. Thus, the Doan et al. reference only makes passing mention of HfO_2 deposition among many other deposited films.[2] More importantly, Doan et al. does not teach or suggest any process parameters for performing HfO_2 deposition, and does not include any hint of selecting particular process parameters to achieve a substantially constant result among the wafers in a batch. Thus, Doan et al. does not teach the precursor, process parameters or process result listed above and now explicitly included in Claim 1.

Applicants further submit that the several secondary references in this case also do not disclose all of the above listed parameters. For example, the outstanding Office Action cites Leskela et al. as teaching the precursors $Hf(NEt_2)_4$ and $Hf(NEtMe)_4$ now recited in Claim 1. However, Leskela et al. discloses generic chemical formulas and specific compounds that encompass a very large number of possible precursors for depositing nitride barrier layer conducting films. In particular, Leskela et al. teach that the chief difficulty in the chemical processing of transition metal nitrides is in reducing the metal, since in the generally used

2 See Doan et al. at paragraphs 29 and 43.

source materials, the oxidation state (of the metal) is higher than in the (metal) nitride to be produced. The chemical compounds in Leskela et al. are selected to eliminate the difficulty relating to reducing the metal by using nitrogen source materials that have more reducing properties than previously known.

However, there is nothing in Leskela to teach or suggest forming HfO_2 films, which are dielectric films that are unsuitable for use as a barrier layer film. Thus, even assuming that the claimed $Hf(NEt_2)_4$ and $Hf(NEtMe)_4$ precursors now recited in Claim 1 can be obtained from a reading of Leskela, there is no reason why one of skill in the art would select these precursors from the many possibilities in Leskela to deposit an HfO_2 which is not even mentioned in Leskela. Further Hf is neither reduced nor oxidized in the deposition process (oxidation state of Hf stays at +4) of Claim 1 (See Leskela et al. at paragraphs 8 and 13). As noted above, it is the present inventors that identified the specific claimed precursors as suitable for performing a batch type ALD HfO_2 process with acceptably constant properties across all substrates. Selection of these precursors from the many possible nitride precursors in Leskela et al. would be improper hindsight reasoning.

Finally, Applicants cannot find any discussion in any of the nine cited references relating to the selection of the process parameters listed above in order to achieve substantially constant results across the batch type processing system. Indeed, the majority of the references cited do not relate to a batch type ALD processing system at all. Thus, even assuming that the individual process parameters listed above can be found among the diverse references, Applicants submit that one of ordinary skill in the art would have no reason to combine such diverse teachings into the process recited in Claim 1. As noted above, it is Applicants who first recognized the difficulty in obtaining constant results across a batch in ALD deposition of HfO_2, and took steps to achieve this result. Applicants submit that to

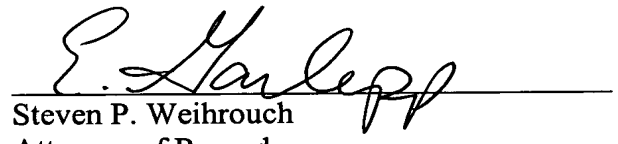
select Applicants' discovered process parameters from diverse references (many directed to single substrate processing) would be impermissible hindsight reasoning.

For the reasons discussed above, Applicants submit that Claim 1 as amended herein patentably defines over the cited references. As the remaining pending claims in this case depend from Claim 1, these claims also patentably define over the cited references.

Consequently, in view of the present amendment, no further issues are believed to be outstanding in the present application and the present application is believed to be in condition for formal allowance. An early and favorable action is therefore respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



Steven P. Weihrouch
Attorney of Record
Registration No. 32,829

Edwin D. Garlepp
Registration No. 45,330

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 03/06)
I:\ATTY\EDG\241482US-AM DUE 5-7-07 FILED.DOC